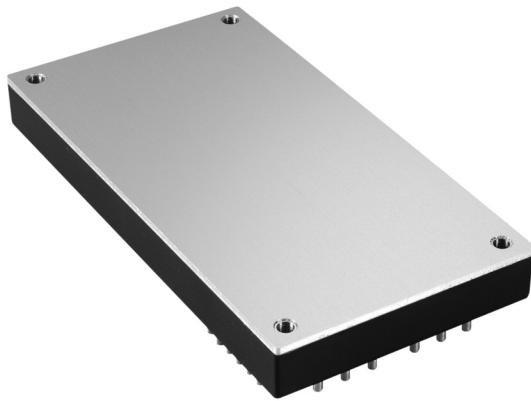


# QSB600



- 600–700 W Isolated Output
- Up to 92% Efficiency
- Industry Standard Full Brick Package
- –40 °C to +100 °C Operating Temperature
- High Power Density
- Baseplate-cooled and Mounting Holes for Easy Integration
- Remote On/Off & Remote Sense
- 3 Year Warranty

This specification describes the features and functions of QSB600 series of isolated DC-DC Converters.

The QSB600 series can deliver up to 50 A output current and provides a regulated output voltage over a wide input voltage range of 18-36 and 36-75 VDC with efficiency up to 92%. The mechanical construction offers a direct cooling through a metal baseplate for excellent thermal performance. Standard features include isolated remote on/off (positive or negative), remote sense, output voltage adjustment, over voltage, over current and over temperature protection. The modules can be connected in parallel for higher power requirements.

## Input Characteristics

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Input Voltage	18	24	36	VDC	24 VDC nominal input
	36	48	75	VDC	48 VDC nominal input
UVLO Turn On	16	17	18	VDC	24 VDC nominal input
	34	35	36		48 VDC nominal input
UVLO Turn Off	15	16	17	VDC	24 VDC nominal input
	32	33	34		48 VDC nominal input
Input Current					See models and ratings table, typical and measured at 24 VDC and 48 VDC input
Inhibited Input Current			50	mA	
Inrush Filter					Pi network
Input Reverse Voltage Protection					External components required

## Output Characteristics

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Output Voltage				VDC	See models and ratings table for details
Output Voltage Adjustment	-60		+10	%	of nominal output
Auxilliary Output	7		13	V	Max. of 20 mA (aux. pin 16) Ground reference is -Sense.
Output Current				A	See models and ratings table for details
Output Set Tolerance			±1.5	%	
Ripple & Noise 12 V 28 V 32 V 48 V			120	mV	20 MHz bandwidth, see note 1
			280		
			320		
			480		
Overvoltage Protection	115		140	%	Vout nominal, hiccup mode with auto recovery
Overload Protection	110		150	%	Iout nominal, see fig.1
Short Circuit Protection					Constant current mode until the fault is removed with auto recovery
Overtemperature Protection			110	°C	Baseplate Temperature
Remote Sense			10	%	Total voltage compensation. Includes Vtrim.
Load Regulation			±0.5	%	Vout nominal, measured from 0-100% load
Transient Response			±5	%	Recovery within 1% in less than 500µs for a 50% load change at 0.1A/µs
Line Regulation			±0.2	%	Vout nominal from high line to low line
Start Up Time			250	ms	
Start Up Rise Time			50	ms	
Temperature Coefficient			0.03	%/°C	
Remote On/Off					Reference to -Vin, Module on: 110 mA Module off: <1 mA or open circuit

## Models & Ratings

Input Voltage	Output Voltage	Output Current	Input Current		Efficiency	Model Number <sup>2</sup>
			No Load	Full Load		
18-36 V	12.0 V	50.0 A	150 mA	28.09 A	89.0%	QSB60024S12
	28.0 V	21.5 A	150 mA	27.87 A	90.0%	QSB60024S28
	32.0 V	19.0 A	150 mA	27.84 A	91.0%	QSB60024S32
	48.0 V	12.5 A	200 mA	27.47 A	91.0%	QSB60024S48
36-75 V	12.0 V	50.0 A	90 mA	13.89 A	90.0%	QSB60048S12
	28.0 V	25.0 A	105 mA	16.03 A	91.0%	QSB60048S28
	32.0 V	19.0 A	90 mA	13.77 A	92.0%	QSB60048S32
	48.0 V	12.5 A	130 mA	13.59 A	92.0%	QSB60048S48

**Note:** 1. Output Ripple and Noise measured with 10 µF tantalum and 1 µF ceramic capacitor across output.

2. Add suffix 'P' to the model number to receive the unit with positive logic, Module on: <1 mA or open circuit, Module off: 1-10 mA.

## General Specifications

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency		91		%	See models table and performance graphs
Isolation Voltage			1500	VDC	Input to output
			1500		Input to case
			1500		Output to case
Isolation Resistance	10 <sup>7</sup>			Ω	
Isolation Capacitance			4000	pF	
Switching Frequency		250		kHz	Others
		350		kHz	48 Vin: 12, 28, 32 VDC
MTBF		381		kHrs	MIL-HDBK-217F at 25 °C, GB
DC OK Signal	DC OK TTL low, not OK TTL high, connect IOC pin to Aux pin through a resistor				
Rth Case - Ambient		7.12		°C/W	
Power Density		108.7		W/in <sup>3</sup>	

## Environmental

Characteristic	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating Temperature	-40		100	°C	Baseplate temperature.
Storage Temperature	-55		105	°C	
Humidity			95	%	Relative humidity, MIL-STD-810F Method 507.4
Cooling	Conduction cooling through baseplate.				

## Electromagnetic Compatibility

EMC	Standard	Test Level	Criteria	Notes & Conditions
Conducted Emissions	EN55022	Class A		With external components, see EMC section

## Safety Approvals

Standard	Category
CE	LVD

## Overload Protection

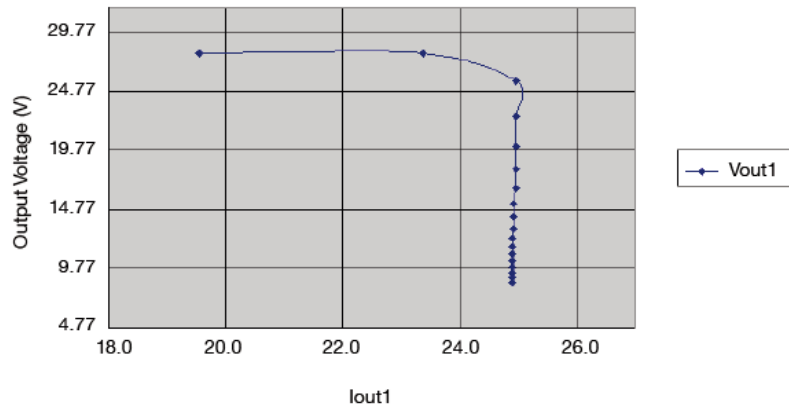


Figure 1. Over current Profile

After reaching the limit between 110% to 140% of  $I_{nom}$  (current or power limit point), the output voltage will reduce and the unit will enter trip and restart mode. Automatic recovery when overload is removed.

## Remote Sensing

The QSB600 series converter has the capability to remotely sense both output lines. This automatically adjusts the output voltage in order to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load. The remote sense voltage range is:  $\leq 10\%$  of  $V_{o\_nominal}$ . If the remote sense is not used, the sense pins should be connected locally where +Sense pin should be connected to +Vout pin and -Sense pin to -Vout pin.

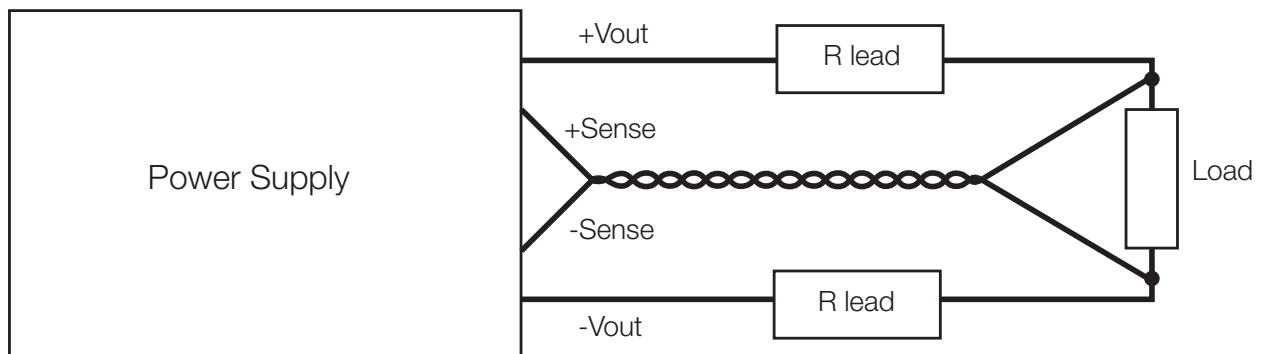


Figure 2. Remote Sense Connection Diagram

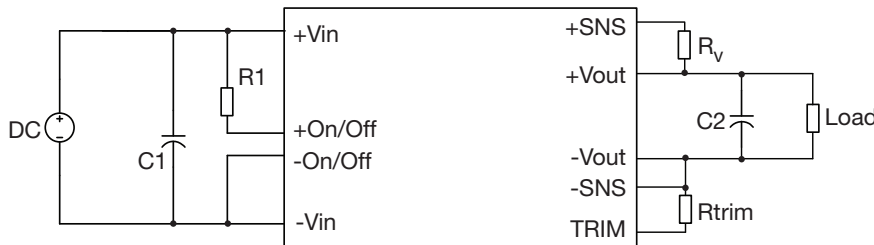
## Output Voltage Adjustment

The trim pin permits the user to adjust the output voltage up or down according to the trim range specification (40% to 110% of nominal output). This is accomplished by connecting resistor  $R_V$  between the +Vout and +Sense pins and a resistor  $R_{trim}$  between the trim and -Sense pins. The trim pin should be left open if trimming is not being used. The trim resistor can be determined by the following equations:

$$V_f = \frac{1.24 \times \left( \frac{R_{trim} \times 33}{R_{trim} + 33} \right)}{7.68 + \frac{R_{trim} \times 33}{R_{trim} + 33}}$$

$$V_{trim} = (V_o + R_V) \times V_f$$

$R_V$ : Variable Resistor, K $\Omega$   
 $R_{trim}$ : K $\Omega$ , 6.2 k $\Omega$  recommended  
 $V_o$ : Nominal Output Voltage



C1: 220  $\mu$ F/100 V  
C2: 470  $\mu$ F/100 V  
Low ESR electrolytic capacitors are recommended

Figure 3. Test and output voltage trim configuration

The capacitor C1 is recommended to be low ESR and is to balance the line inductance on the input of the DC/DC converter. For stable operation, connect a low impedance electrolytic capacitor C2 in the output terminals. When operated at lower temperature than -20  $^{\circ}$ C, increasing the C2 capacitance with three or four times more than the recommended value.

## Parallel Configuration

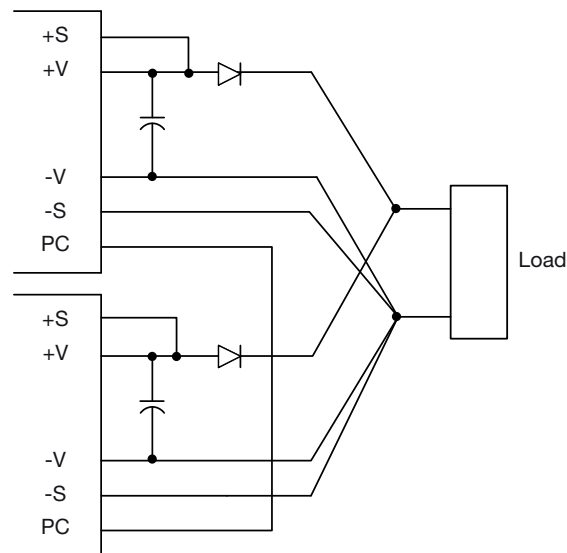


Figure 4. Parallel configuration for current sharing

### Notes.

Up to 4 converters to share within 90% max power.

## Redundant Configuration

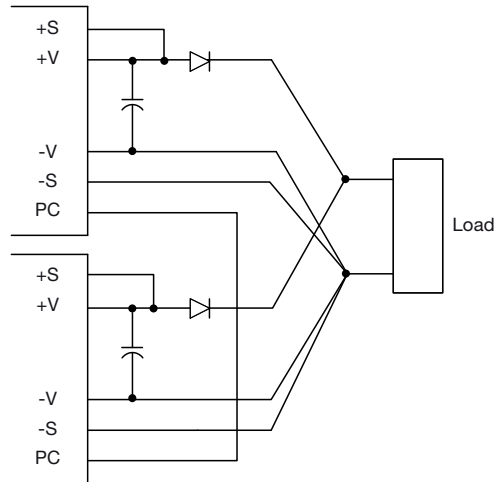


Figure 5 - Redundant configuration

## DC OK Signal

Normal and abnormal operation of the converter can be monitored by using the DC OK signal. This is an open collector output, and it can be connected to the internal aux power supply or to an external DC supply. The ground reference is the -Sense and the current must be limited to 20 mA.

This signal is LOW when the converter is ON and HIGH when the converter is disabled or OFF.

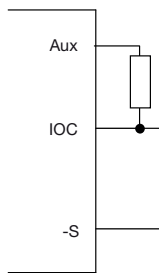


Figure 6 - By internal Aux

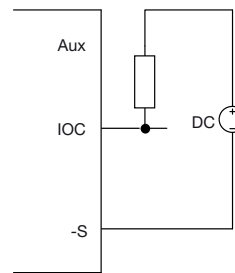
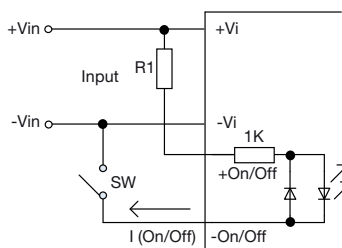


Figure 7 - By internal DC Supply

## Remote On/Off

Output voltage turns on when current flows through the ON/OFF pins by closing the switch. The max current through the On/Off pin is 10 mA max.

Controlling the ON/OFF terminal from the input side, recommended values for R1 are 30k (0.5W) for 48 Vin and 15 k (0.25 W) for 24 Vin.



Controlling the ON/OFF terminal from the output side, recommended R2 value is 5.1k (0.1W).

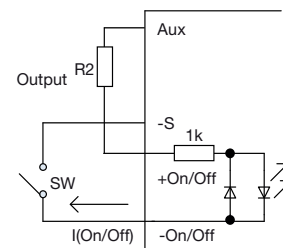
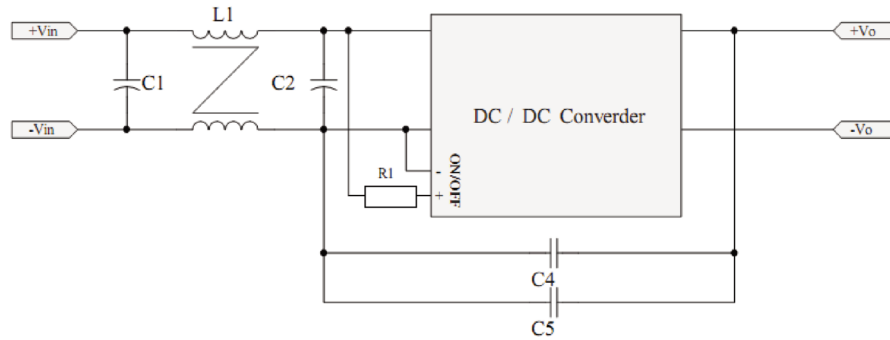


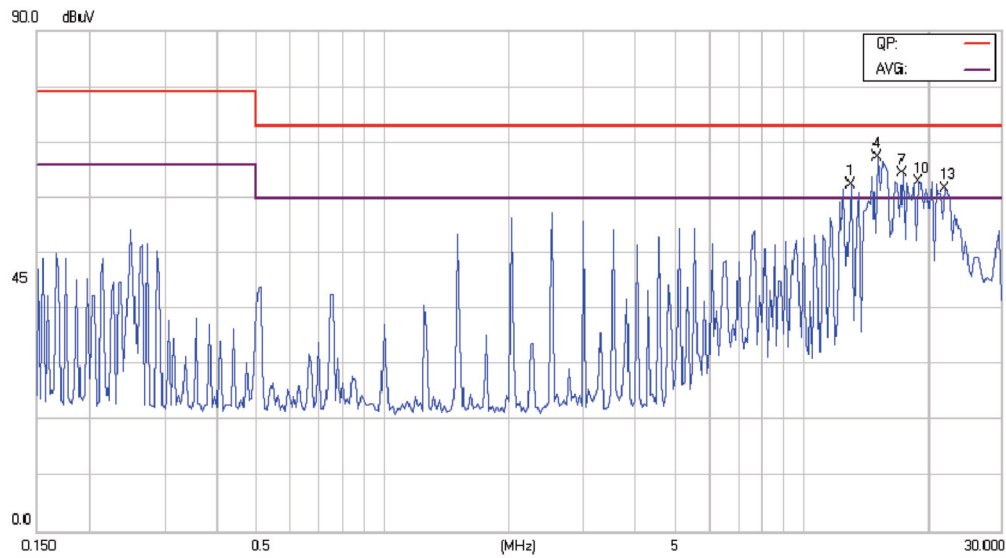
Figure 8 - Remote On/Off

## EMC Connection Diagram and Performance Curve Examples



C1	C2	C4	C5	L1	R1
330 $\mu$ F/50 V	330 $\mu$ F/50 V	1000 pF/2 KV	220 pF/2 KV	0.8 mH	15 K

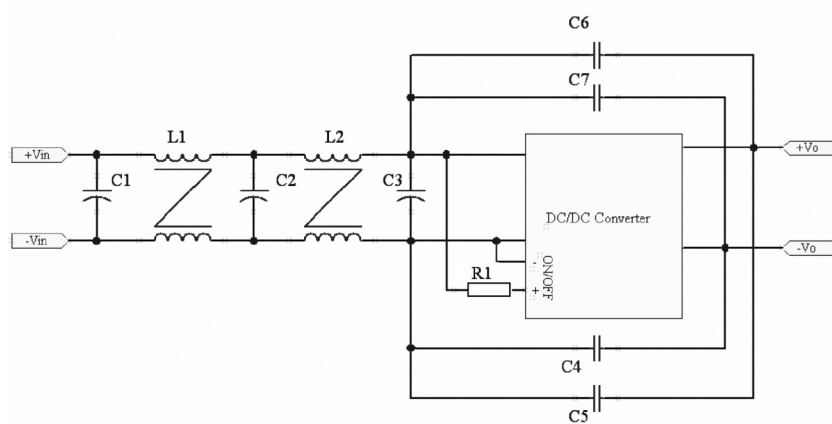
L1: Common mode choke, core p/n T60006-L2025-L0380-05, 4 turns per side, 2 mm or larger diameter wire.



No.	Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measurement (dBuV)	Limit (dBuV)	Over (dB)	Detector
1	13.1966	52.51	10.00	62.51	73.00	-10.49	peak
2	13.1966	42.08	10.00	52.08	73.00	-20.92	QP
3	13.1966	32.85	10.00	42.85	60.00	-17.15	AVG
4	15.2665	57.47	10.00	67.47	73.00	-5.53	peak
5	15.2665	52.19	10.00	62.19	73.00	-10.81	QP
6	15.2665	44.30	10.00	54.30	60.00	-5.70	AVG
7	17.4287	54.37	10.00	64.37	73.00	-8.63	peak
8	17.4287	48.64	10.00	58.64	73.00	-14.36	QP
9	17.4287	47.64	10.00	57.64	60.00	-2.36	AVG
10	19.1220	53.00	10.00	63.00	73.00	-10.00	peak
11	19.1220	47.26	10.00	57.26	73.00	-15.74	QP
12	19.1220	40.92	10.00	50.92	60.00	-9.08	AVG
13	22.1214	51.86	10.00	61.86	73.00	-11.14	peak
14	22.1214	48.31	10.00	58.31	73.00	-14.69	QP
15	22.1214	42.52	10.00	52.52	60.00	-7.48	AVG

Figure 9 - QSB60024S32 connection diagram and conducted emissions test results for EN55022 class A

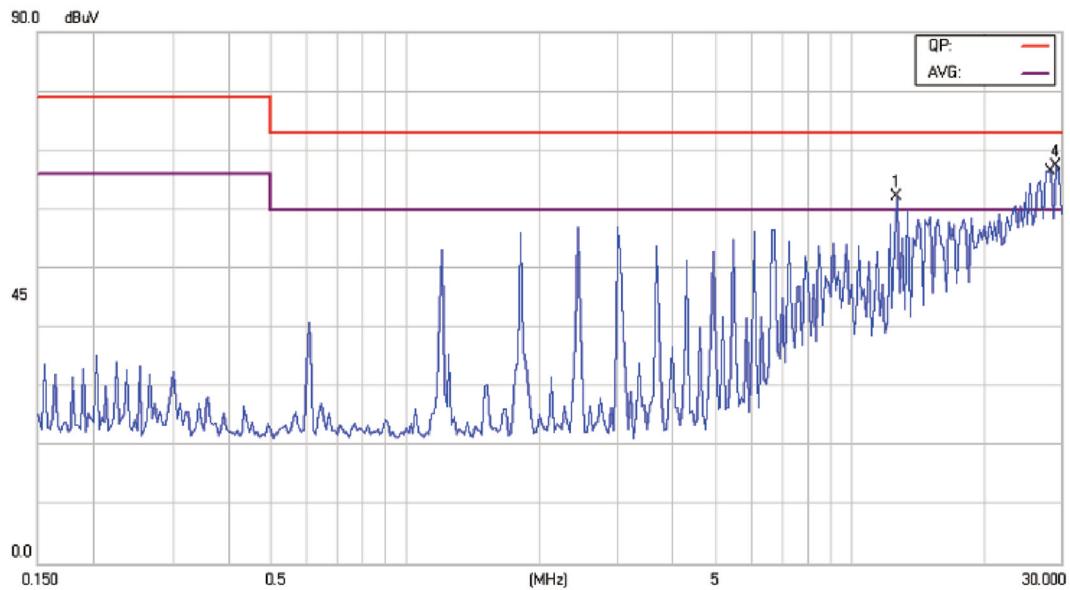
## EMC Connection Diagram and Performance Curve Examples



C1	C2	C3	C4	C5	C6	C7	L1	L2	R1
470 $\mu$ F/100 V	470 $\mu$ F/100 V	470 pF/100 V	2200 pF/2 KV	NC	1000 pF/2 KV	NC	0.8 mH	8 mH	30 K

L1: Common mode choke, core p/n T60006-L2025-L0380-05, 4 turns per side, 2 mm or larger diameter wire.

L2: Common mode choke, core p/n T60006-L2030-W517-03, 9 turns per side, 2 mm or larger diameter wire.



No.	Frequency (MHz)	Reading Level (dBuV)	Correct Factor (dB)	Measurement (dBuV)	Limit (dBuV)	Over (dB)	Detector
1	12.8516	52.51	10.00	62.31	73.00	-10.49	peak
2	12.8516	46.26	10.00	56.26	73.00	-16.74	QP
3	12.8516	37.52	10.00	47.52	60.00	-12.48	AVG
4	29.2157	57.43	10.00	67.43	73.00	-5.57	peak
5	29.2157	43.08	10.00	53.08	73.00	-19.92	QP
6	29.2157	33.24	10.00	43.24	60.00	-16.76	AVG

Figure 10. QSB60048S32 connection diagram and conducted emissions test results for EN55022 class A



## Efficiency vs Load

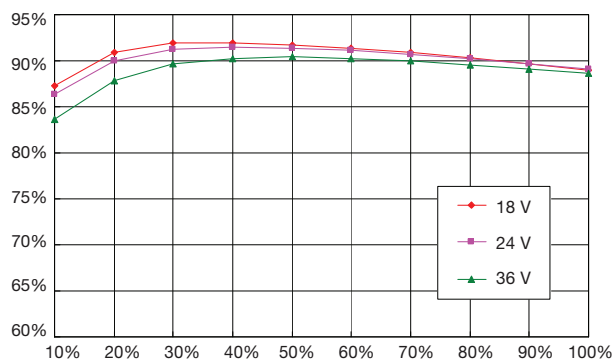


Figure 11. QSB60024S12

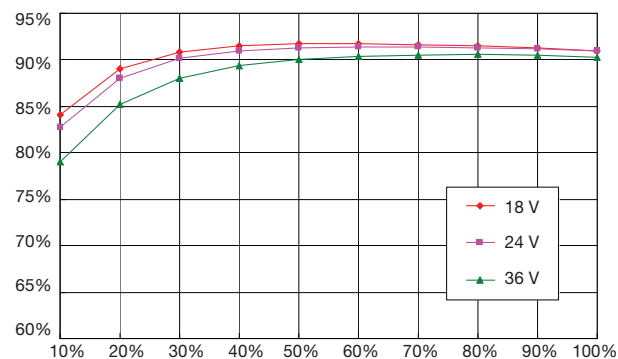


Figure 12. QSB60048S12

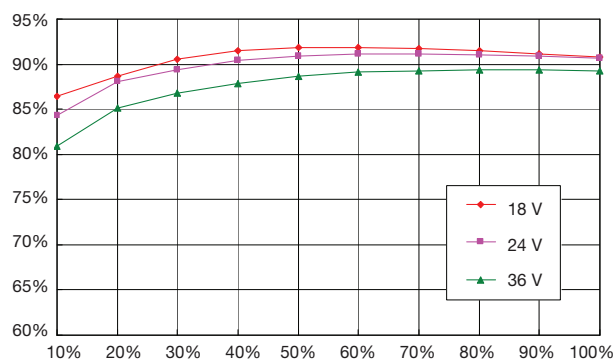


Figure 13. QSB60024S28

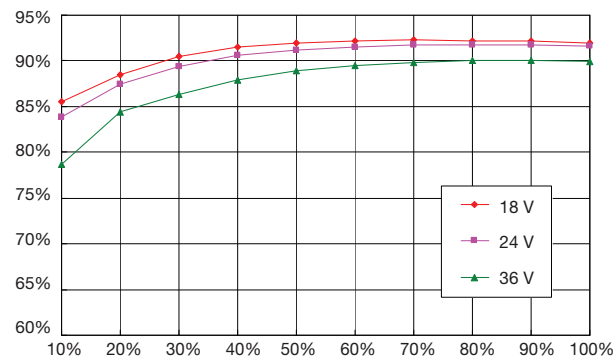


Figure 14. QSB60048S28

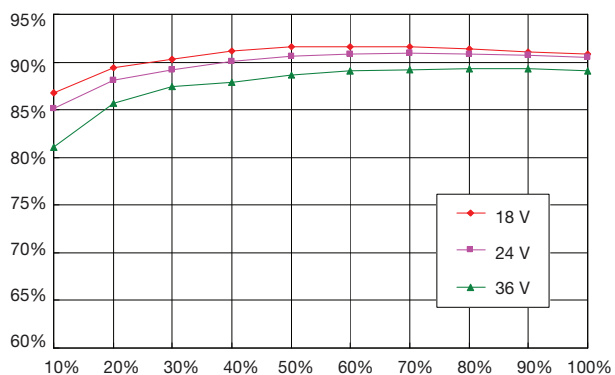


Figure 15. QSB60024S32

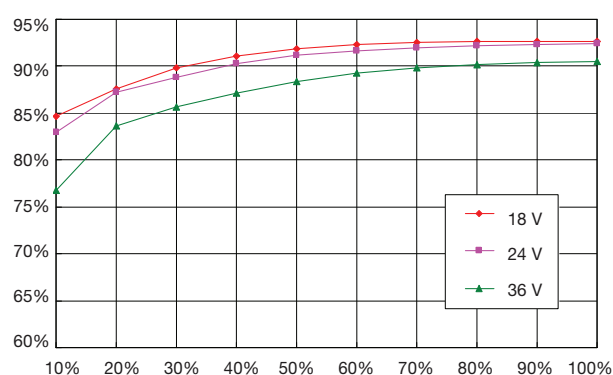
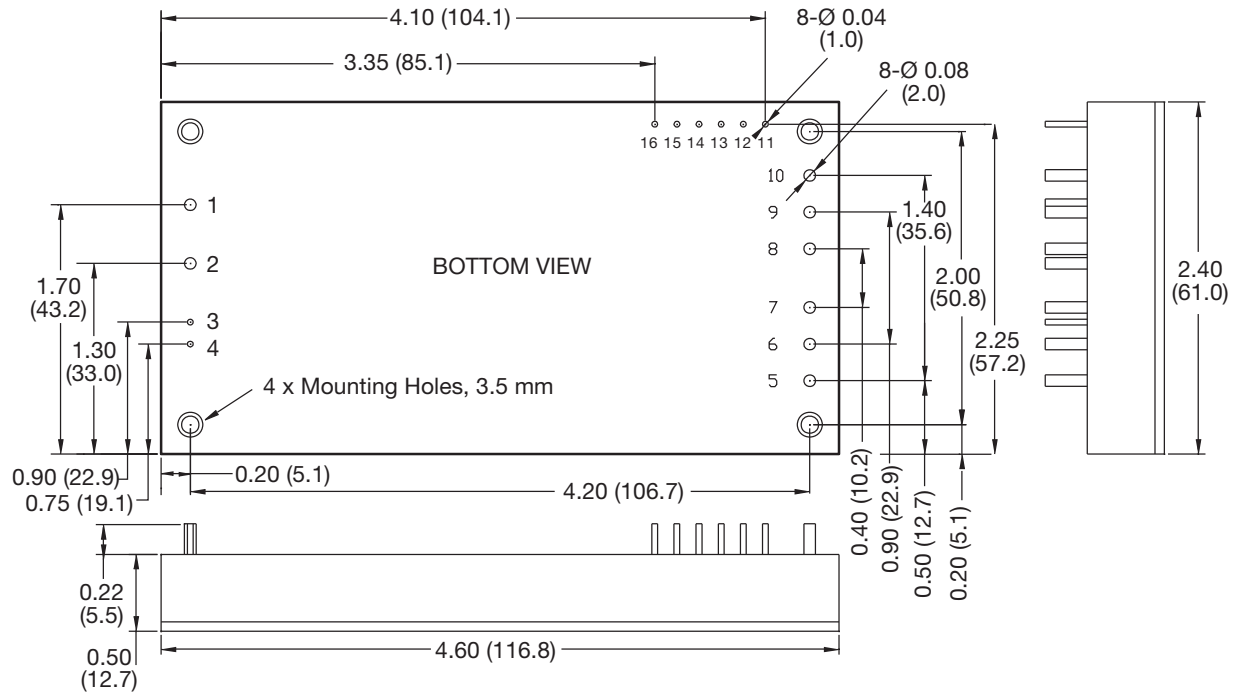


Figure 16. QSB60048S32

## Mechanical Details



PIN CONNECTIONS	
Pin	Function
1	-Vin
2	+Vin
3	-On/Off
4	+On/Off
5-7	+Vout
8-10	-Vout
11	-Sense
12	+Sense
13	Trim
14	PC
15	IOC (DC OK)
16	Aux

## Notes

1. All dimensions are in inches (mm)
2. Weight: 0.49 lbs (220 g) approx

3. Tolerances: X.XX =  $\pm 0.02$  (X.X =  $\pm 0.5$ )  
X.XXX =  $\pm 0.01$  (X.XX =  $\pm 0.25$ )